



US008015048B2

(12) **United States Patent**  
**Bullock et al.**

(10) **Patent No.:** **US 8,015,048 B2**  
(45) **Date of Patent:** **\*Sep. 6, 2011**

(54) **SYSTEM AND METHOD FOR MATCHING HUMAN RESOURCES TO HUMAN RESOURCE NEEDS**

(75) Inventors: **John Bullock**, Denver, CO (US); **John Motler**, Littleton, CO (US); **John Miller**, Lakewood, CO (US)

(73) Assignee: **IQNavigator**, Centennial, CO (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/277,155**

(22) Filed: **Nov. 24, 2008**

(65) **Prior Publication Data**

US 2009/0125353 A1 May 14, 2009

**Related U.S. Application Data**

(63) Continuation of application No. 10/042,731, filed on Dec. 21, 2000, now Pat. No. 7,457,764.

(60) Provisional application No. 60/180,421, filed on Feb. 4, 2000.

(51) **Int. Cl.**  
**G06Q 10/00** (2006.01)

(52) **U.S. Cl.** ..... **705/7.14; 705/7.17; 705/7.23**

(58) **Field of Classification Search** ..... **705/8, 9, 705/7.14, 7.17, 7.23**

See application file for complete search history.

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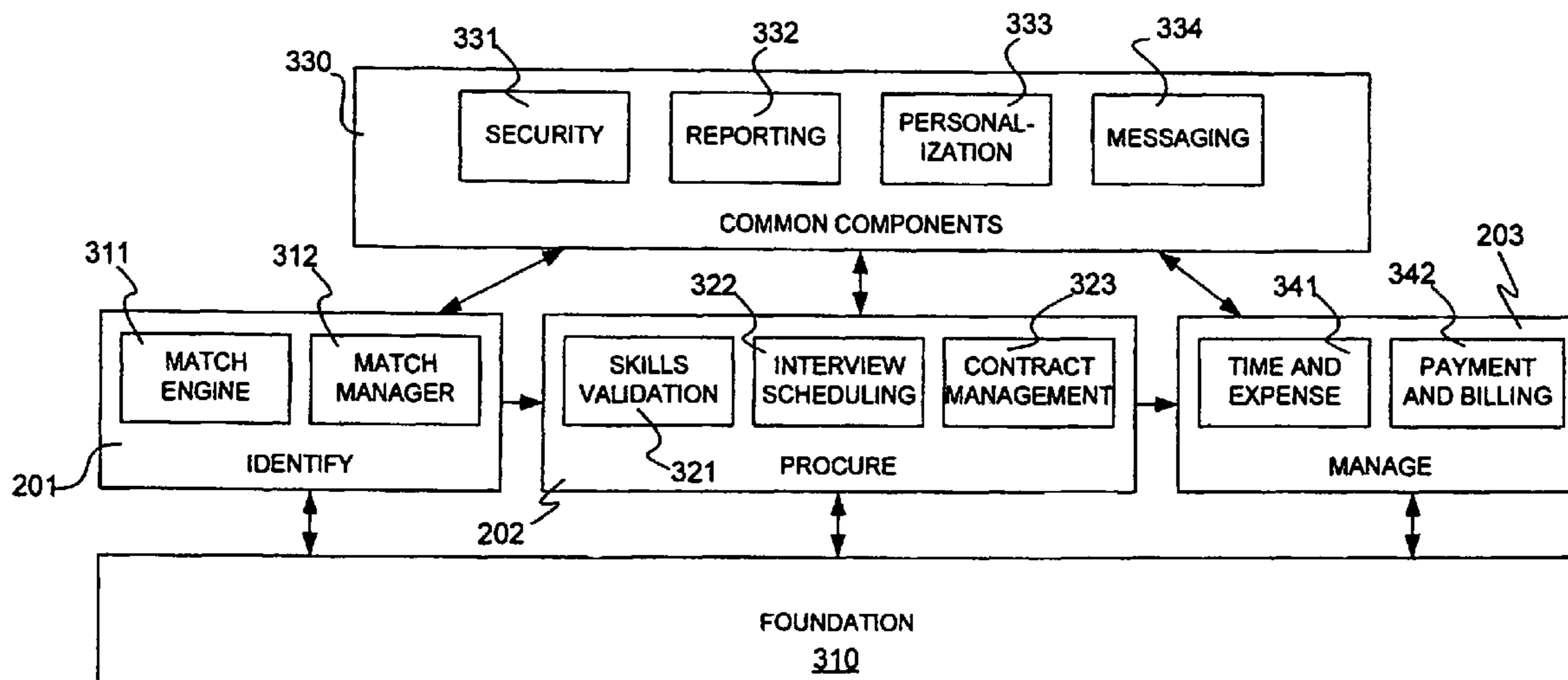
*Primary Examiner* — Johnna Loftis

(74) *Attorney, Agent, or Firm* — Hogan Lovells US LLP

(57) **ABSTRACT**

A system for matching entities having needs to entities having capability to meet the needs. A plurality of needs profiles are created, where each need profile comprises a data record specifying attributes about a need. A plurality of capability profiles are also created, where each capability profile comprises a data record specifying set of attributes of an entity having a capability of meeting a need. A matching engine is coupled to repetitively and automatically examine the needs profiles and capability profiles to identify matched profiles, wherein a match comprises a set of profiles judged to be substantially compatible based upon correspondence of the attributes specified therein.

**14 Claims, 9 Drawing Sheets**



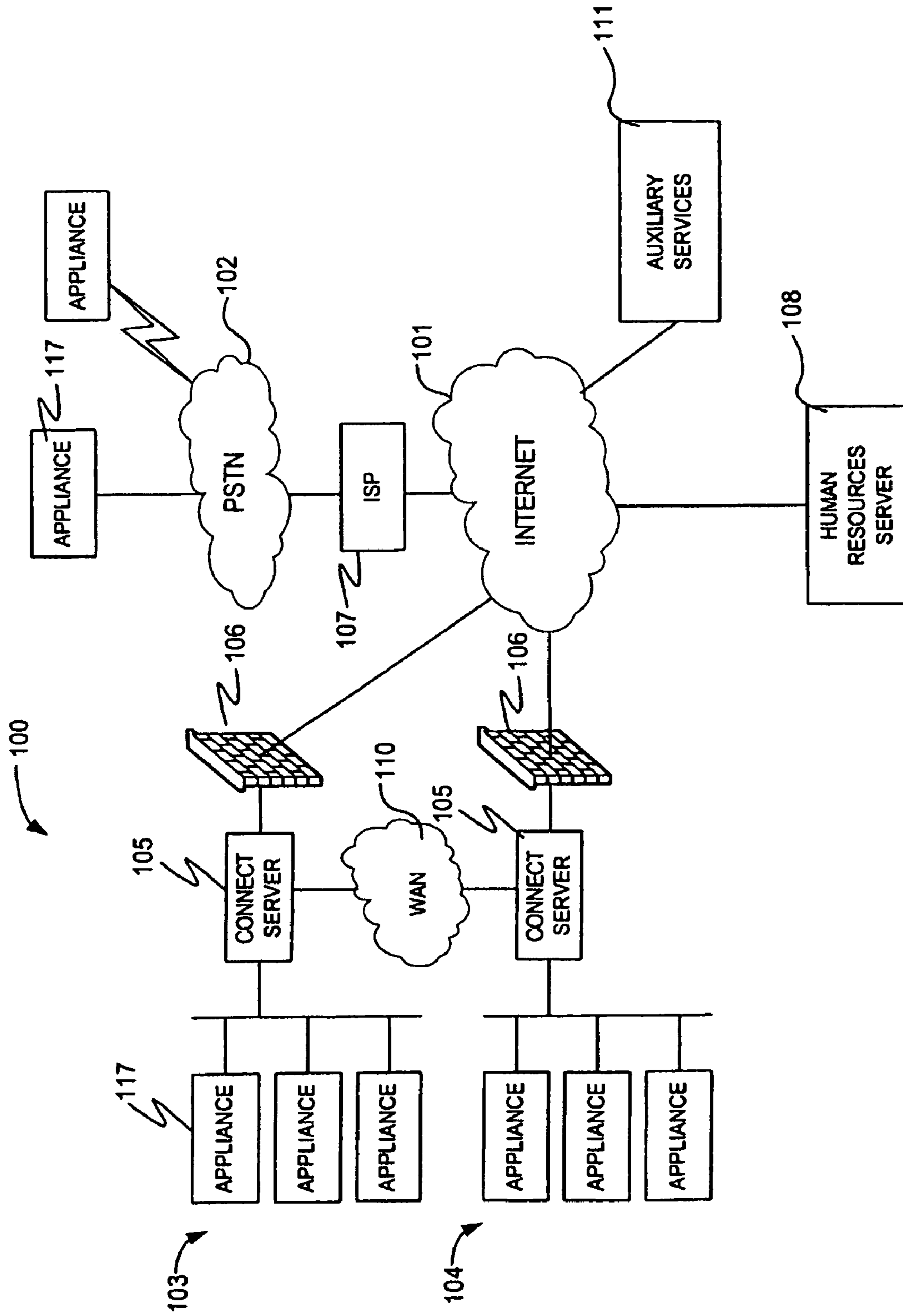


FIG. 1

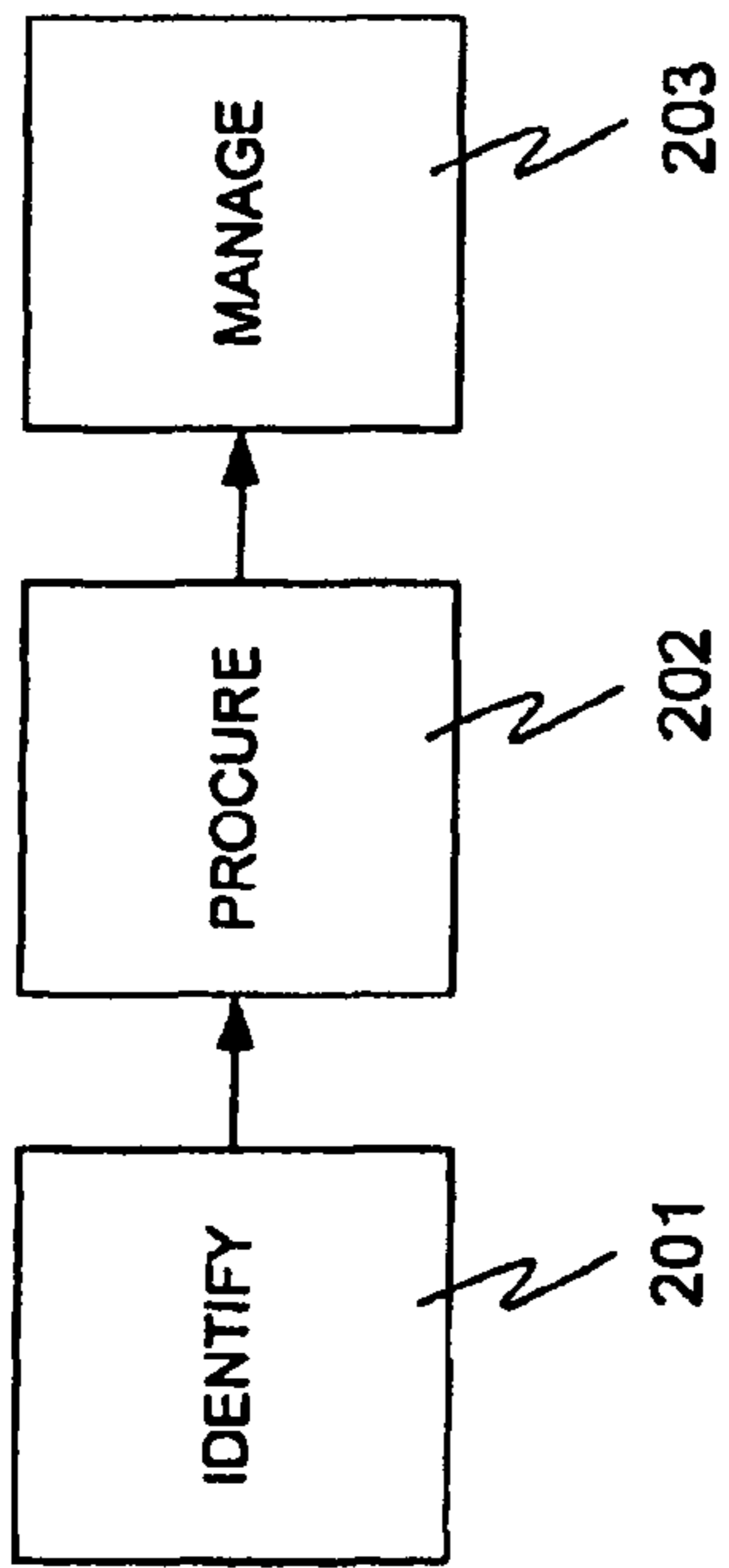


FIG. 2

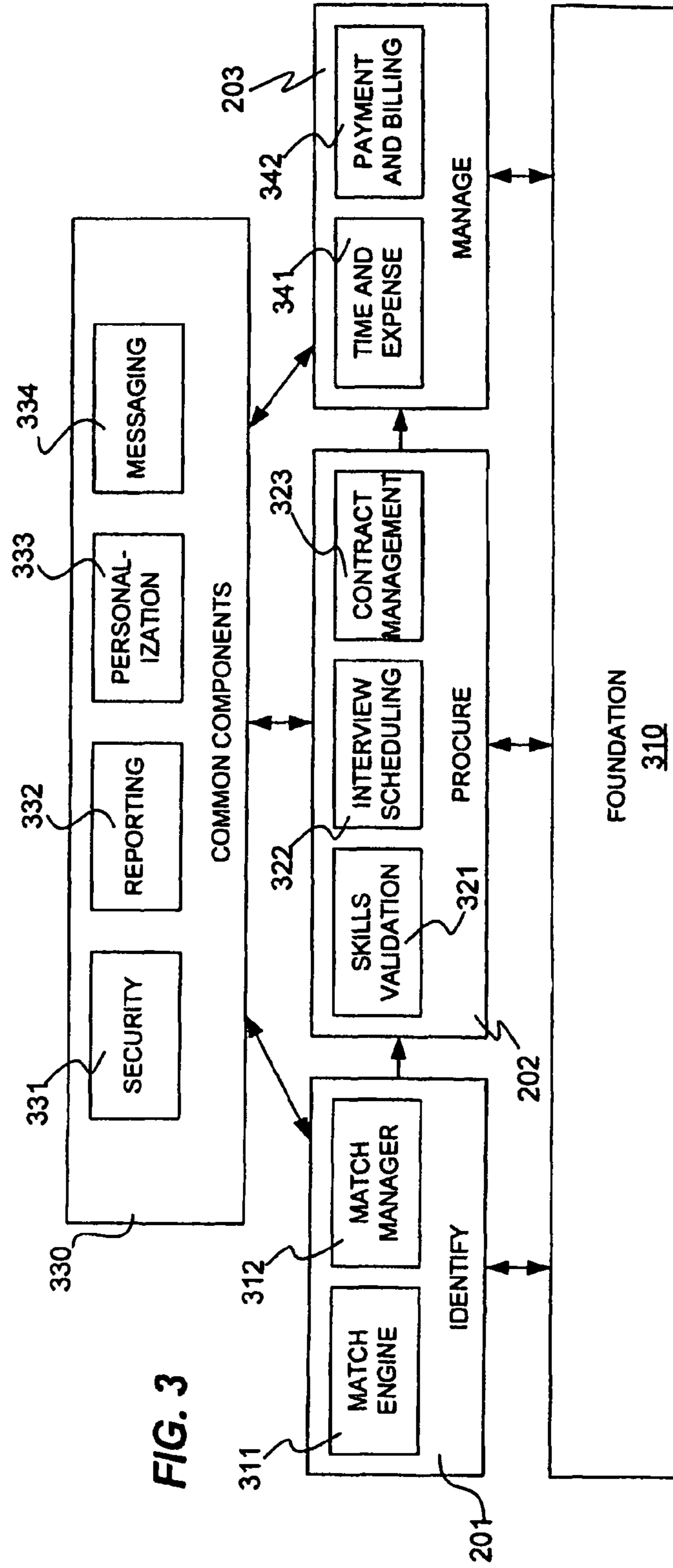


FIG. 3

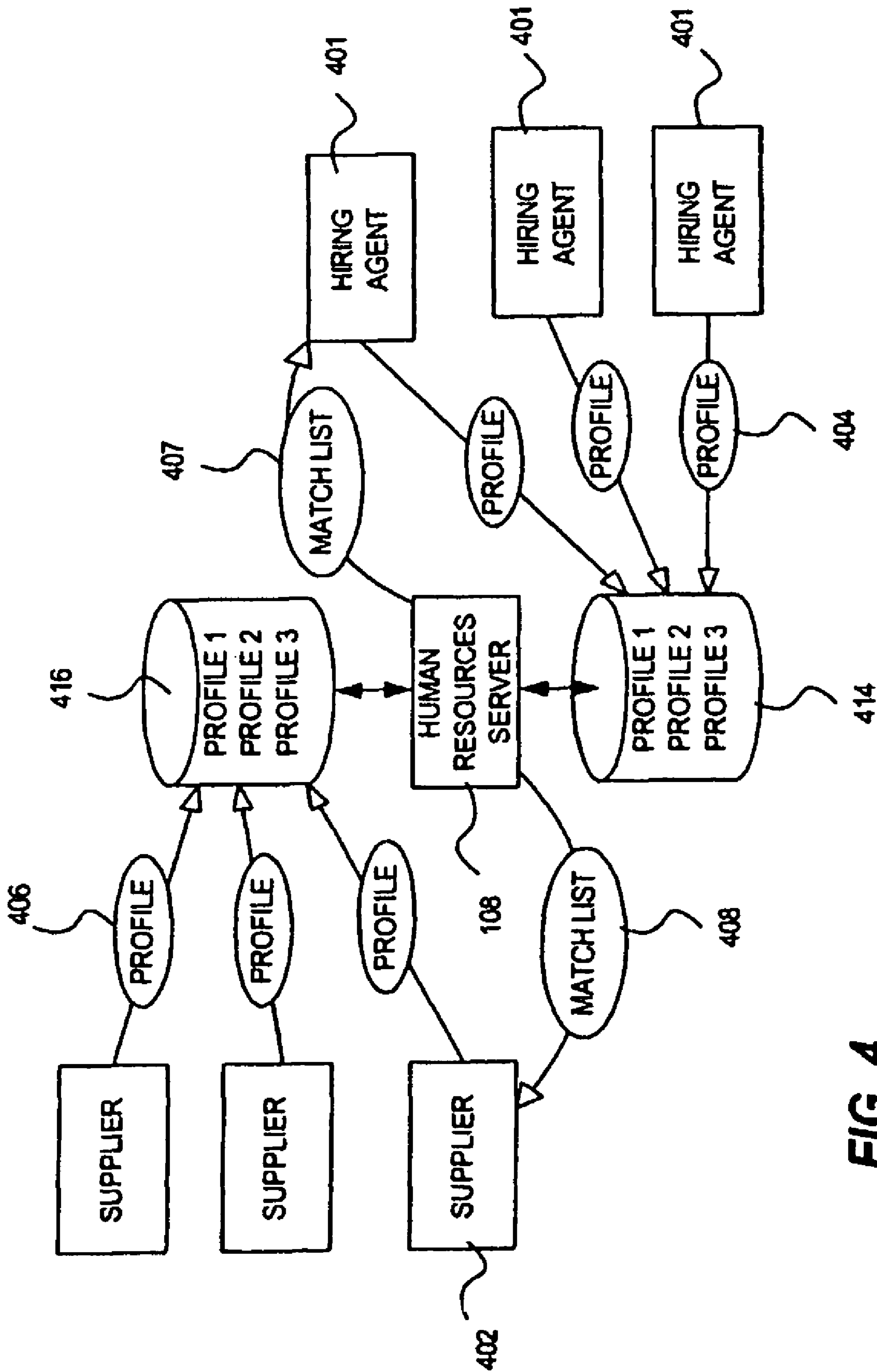


FIG. 4

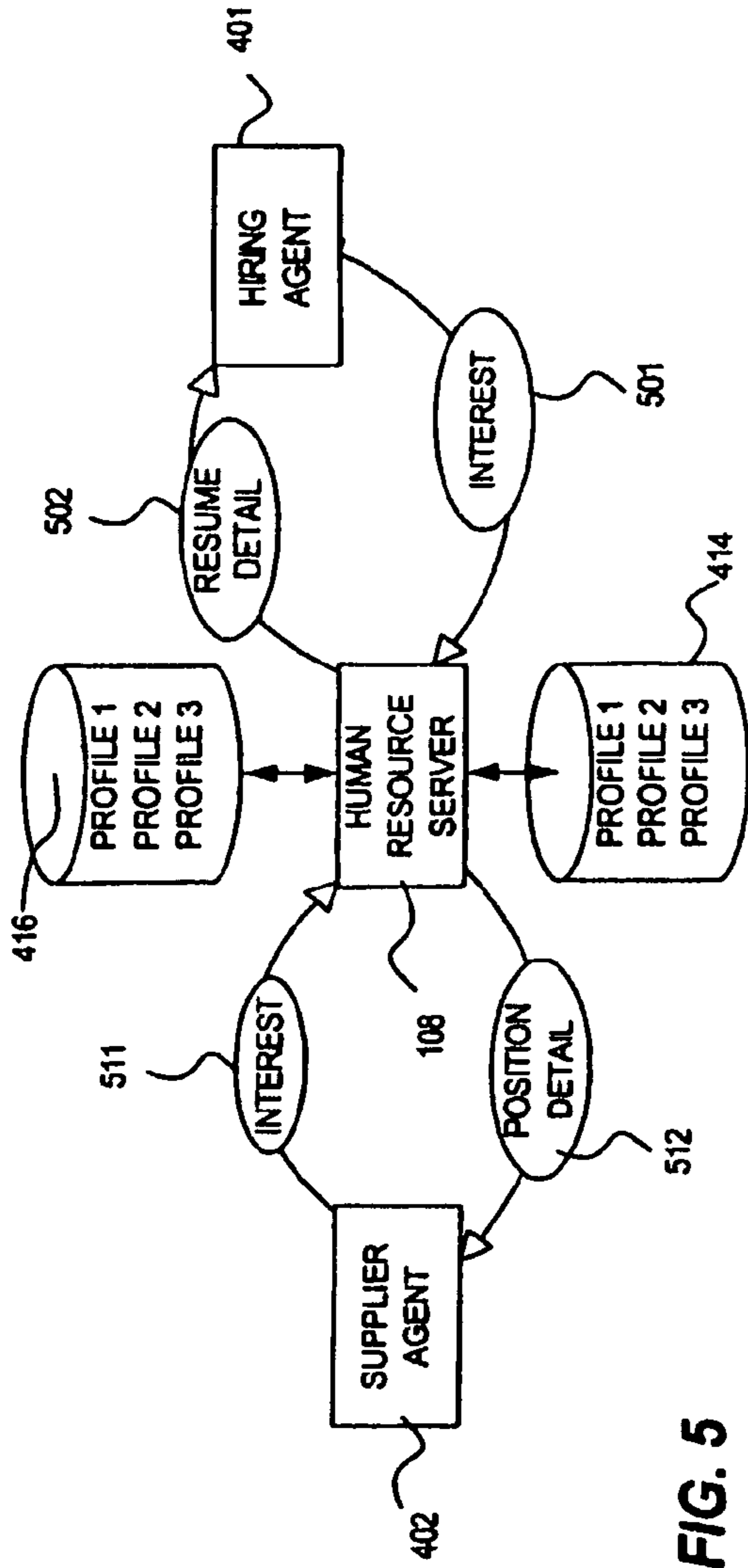


FIG. 5

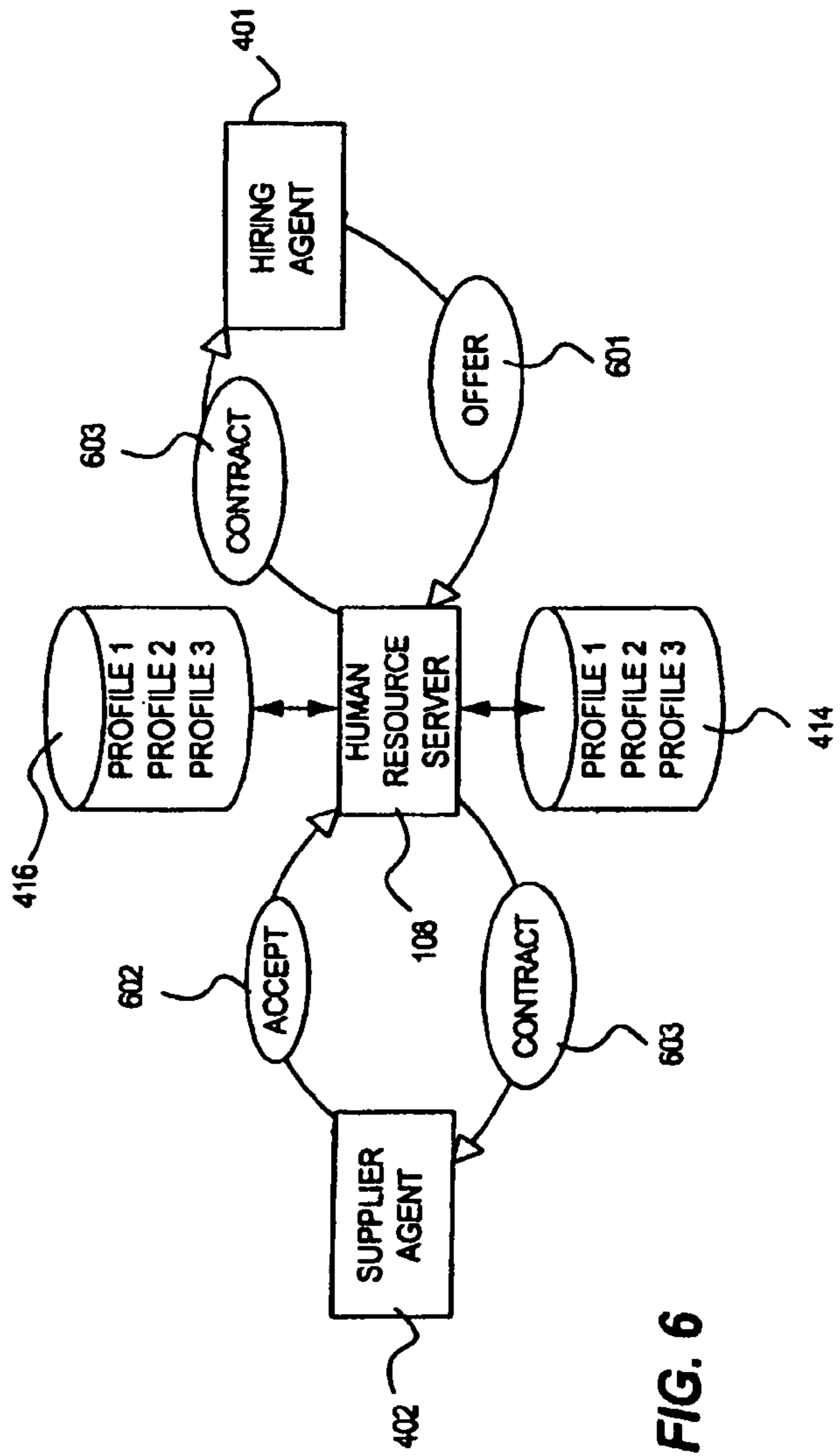


FIG. 6

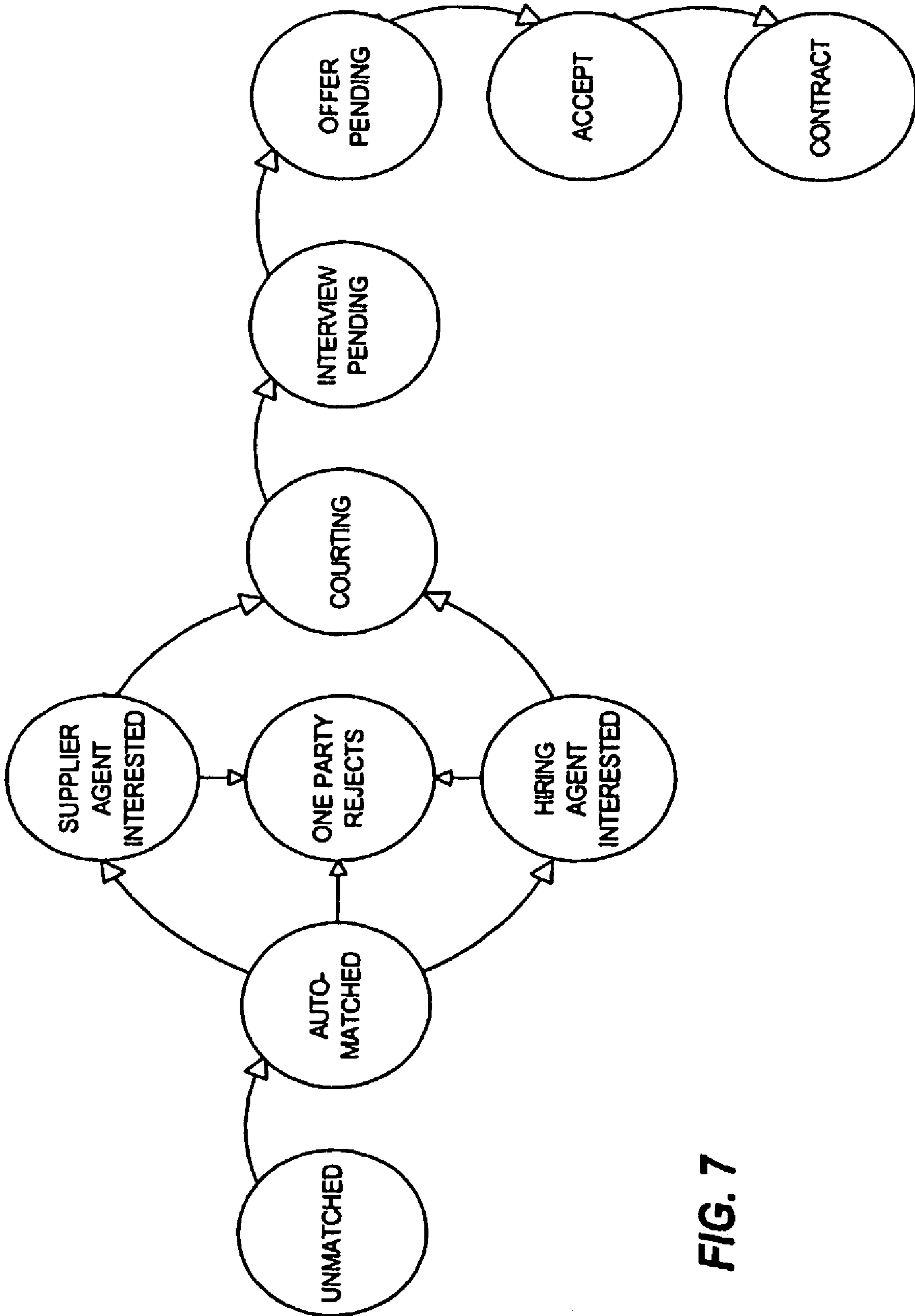


FIG. 7

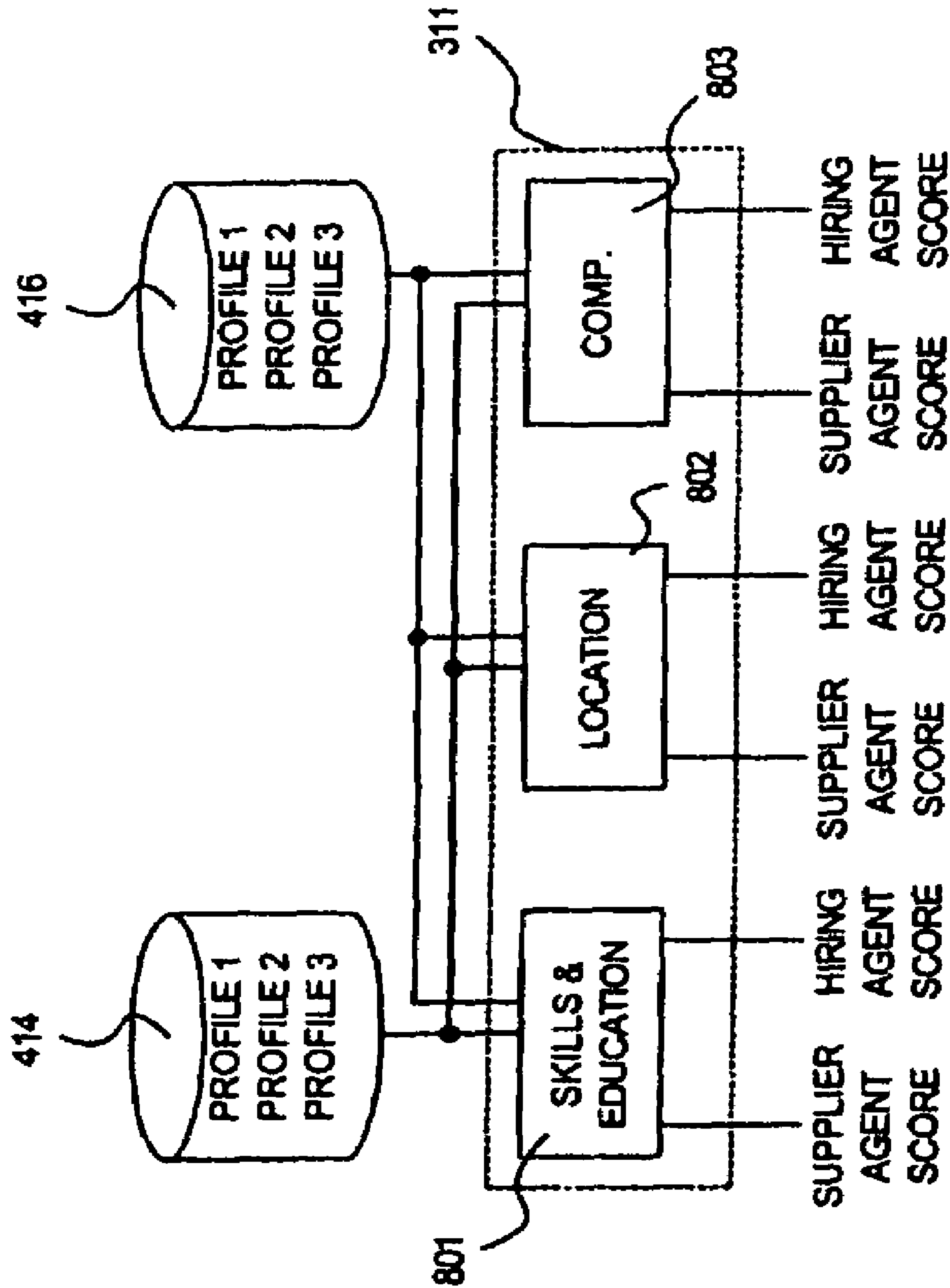


FIG. 8

**BROWSER: General Resource Information**

First Name:  Title:  SSN:

E-mail:  Daytime Phone:  Evening Phone:  Status:  Active  Inactive

Resource Type:  Contract  Contract to Hire  Direct Hire

Available to Interview As of:  Available to Start:  Managing Supplier Agent(s):

Geographic Preference:  Referred By:

**Skills/Roles Criteria**

Please specify at least one skill and one role

Skill 1  Skill 1 Skill 2 Skill 3 Skill 4

Role 1  Role 1 Role 2 Role 3 Role 4

Available Supplier Agents:

FIG. 9



**BROWSER: General Resource Information (Cont.)**

Skills/Role Detail	Level	Years Exp	Preference	Visibility	Delete
Skill 1	Expert	12	Not Required	Protected	<input type="checkbox"/>
Skill 2	Novice	1.5	Required	Public	<input type="checkbox"/>
Skill 4	Trained	1	Required	Public	<input type="checkbox"/>
Role 2	Guru	12	Required	Public	<input type="checkbox"/>
Role 4	Expert	12	Not Required	Private	<input type="checkbox"/>

Resume:

**UPLOAD RESUME**

Compensation:

Hourly	50.00	Protected
Daily		Private
Monthly		Private
Annual		Private

Other:

Job Consideration:

Payer  YES  NO  
 Overtime  YES  NO  
 Travel  YES  NO  
 Telecommute  YES  NO

Preference:

YES  NO  
 YES  NO  
 YES  NO  
 YES  NO

Comment:

FIG. 10

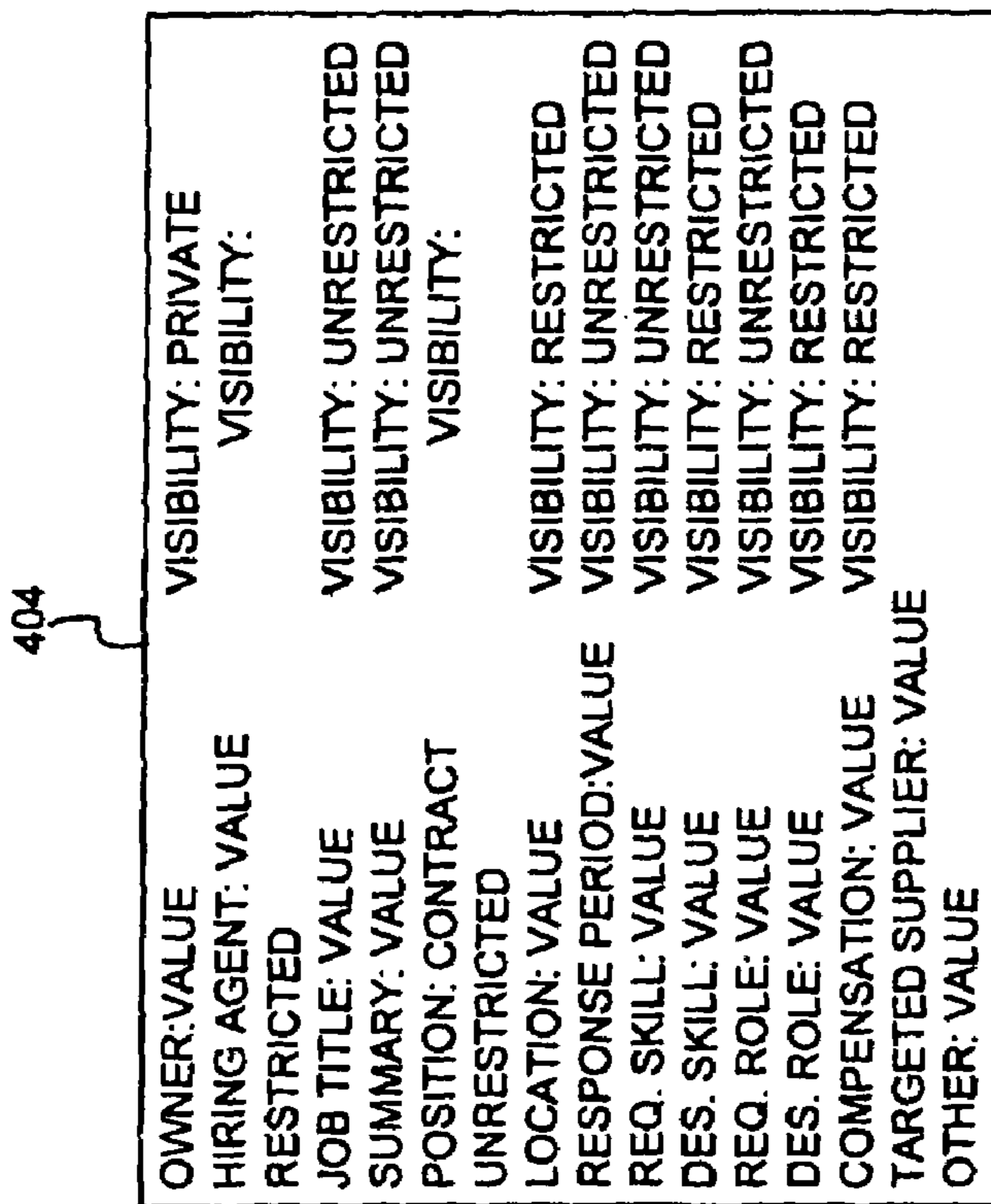
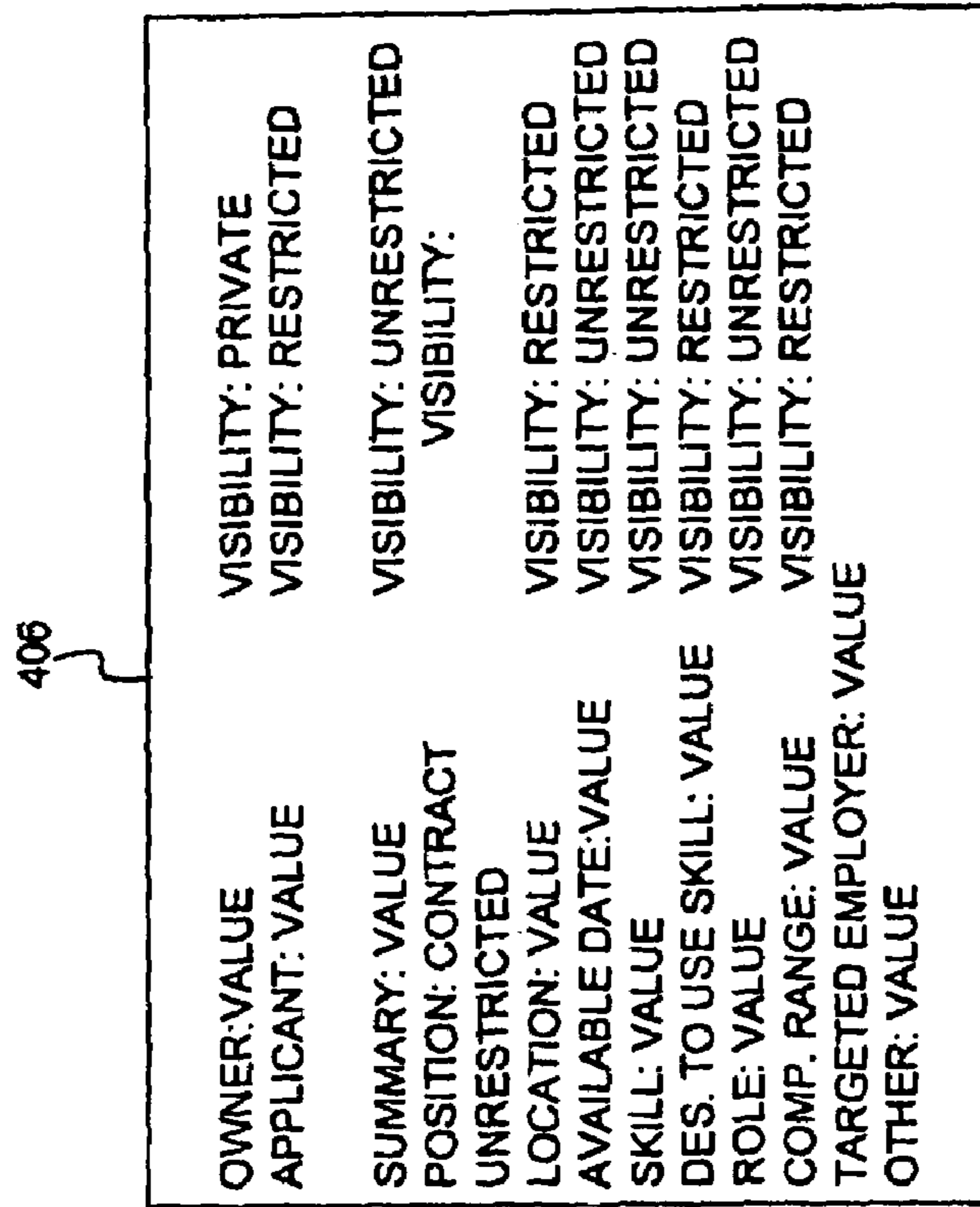


FIG. 11

FIG. 12

# SYSTEM AND METHOD FOR MATCHING HUMAN RESOURCES TO HUMAN RESOURCE NEEDS

## RELATED APPLICATIONS

The present invention claims priority to copending U.S. patent application Ser. No. 10/042,731 filed Dec. 21, 2000, and entitled System And Method For Matching Human Resources To Human Resource Needs, which claims the benefit of U.S. Provisional Patent Application No. 60/180,421 entitled ELECTRONIC RESOURCE MANAGEMENT SYSTEM filed Feb. 4, 2000, both applications being incorporated herein in their entireties by this reference.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates, in general, to resource management, and, more particularly, to software, systems and methods for matching human resources to human resource needs of an organization.

### 2. Relevant Background

The world economy is characterized by a scarcity of skilled human resources for a variety of jobs. As the educational and experience requirements increase in a technological society, the pool of people having necessary and desired skills becomes smaller. This creates a situation in which many jobs are chasing fewer and fewer skilled workers. This is complicated in many industries, employees tend to move from job to job every few years. This is particularly true of skilled employees and even more particularly true in the information technologies industries. An advantage in identifying, obtaining and managing employees represents a significant strategic advantage for an organization.

It is increasingly difficult for employers to identify and hire qualified employees and contractors for particular positions. Human resource needs often arise suddenly and unpredictably, but must be filled quickly. With product development cycles and product life cycles becoming shorter, personnel with needed skills must be identified and hired quickly. At the same time, each candidate and position must be sufficiently analyzed to make meaningful decisions.

Job matching systems tend to be modeled after bulletin boards where available positions and/or applicants are posted and the other party must periodically peruse or search through the postings. This is inefficient because the participants are only made aware of other participants at the instant they conduct a search or log on. A new job applicant that registers moments after a search was performed will not be reported to the searching party, for example. Hence, participants must access the system frequently and conduct searches to obtain up-to-date information.

Search-based systems have limited ability to deal with the various words, terms and syntax used in the postings. A given job posting, for example, is amenable to a variety of expressions and it is difficult, even with natural language search engines, to effectively search through the various listings and leave with certainty that the most relevant matches have been found by the search engine. Many words and terms in the English language, when viewed in context, imply much more than the word's literal definition. Strict text-based matching used by search engines miss these implications. Even fuzzy matching, which is often based upon a word's syntax, synonyms, antonyms and the like, tend to miss complex meanings that are implied by simple words and the context in which they are used. For example, a job applicant may

express that they have Java programming experience, which a typical search tool will match with job descriptions that call for Java experience. However, such experience implies that the applicant has object-oriented programming knowledge which would not be identified by conventional search engines and fuzzy matching techniques. A need exists for a system and method that overcomes the limitations of search-based systems to detect, imply, and deduce matches in a context-sensitive manner.

Another limitation of conventional systems is that even where an applicant's abilities and skills are accurately expressed, there is no way for the applicant to express a desire to use those skills in future employment. To retain workers it is desirable to find workers that are interested in the job and interested in the skills required by the job. For example, a person may be a skilled Cobol programmer, but uninterested in taking a position that uses those skills. Conventional worker identification systems do not consider worker interests and desires and so risk creating job matches that will be difficult to manage and maintain over time.

In-person job matching through conventional interviews and negotiation is inefficient, time consuming, and expensive. Also, it tends to be biased as the participants may express different needs and desires in an attempt to satisfy perceived requirements of the other party. This bias can result in sub-optimal matching of human resources to human resource needs.

A need also exists for systems and software that provide services beyond the identification and matching of potential candidates to job openings. Once a match is defined the life cycle of a typical hiring process continues through negotiations, travel, interviews, testing, and contracting among other steps. These steps are typically managed manually using lists or personal information management products. Hence, a need exists for providing follow-up on services to manage the hiring process in an integrated fashion.

## SUMMARY OF THE INVENTION

Briefly stated, the present invention involves a system for matching entities having needs to entities having capability to meet the needs. A plurality of needs profiles are created, where each need profile comprises a data record specifying attributes about a need. A plurality of capability profiles are also created, where each capability profile comprises a data record specifying set of attributes of an entity having a capability of meeting a need. A matching engine is coupled to repetitively and automatically examine the needs profiles and capability profiles to identify matched profiles, wherein a match comprises a set of profiles judged to be substantially compatible based upon correspondence of the attributes specified therein.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a networked computer environment in which the present invention is implemented;

FIG. 2 shows an basic business processes involved in an implementation of the present invention is implemented;

FIG. 3 shows a particular implementation of the present invention;

FIG. 4 illustrates exemplary entities and data transactions in an implementation of the present invention;

FIG. 5 illustrates activities of a match manager component of the present invention;

FIG. 6 illustrates data exchanges associated with an actual employment or consulting contract being formed;

FIG. 7 shows exemplary state transitions involved in the matching and post match management processes in accordance with an embodiment of the present invention;

FIG. 8 illustrates functional components, typically implemented as software, within an exemplary matching engine;

FIG. 9 and FIG. 10 show exemplary user interfaces used to enter job candidate information for use in a profile; and

FIG. 11 and FIG. 12 illustrate profiles shown in FIG. 4 in greater detail.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows an exemplary computing environment **100** in which the present invention may be implemented. Essentially, FIG. 1 illustrates a network populated by appliances coupled by various network interconnection devices including wide area networks (WANs) **110**, local area networks (LANs), the public switched telephone network (PSTN) **102**, public networks and the like. Environment **100** includes a plurality of local networks **103** and **104** that comprise, for example, Ethernet networks, FDDI networks, Token ring networks and the like.

Essentially, a number of computing devices and groups of devices are interconnected through a network **101**. For example, local networks **103** and **104** are each coupled to network **101** through connect servers **105**. LANs **103** and **104** may be implemented using any available topology and may implement one or more server technologies including, for example a UNIX, Novell, or Windows NT, or peer-to-peer type network. Each network will include distributed storage implemented in each device and typically includes some mass storage device coupled to or managed by a server computer. Network **101** comprises, for example, a public network such as the Internet or another network mechanism such as a fibre channel fabric or conventional WAN technologies.

Local networks **103** and **104** connect one or more computing devices such as computing appliances **117**. One or more appliances **117** may be configured as an application and/or file server. Appliances **117** are used by job applicants, employers, "supplier agents" representing job applicants, and "hiring agents" representing employers to enter data, review data, and invoke services provided by human resources server **108**. Each local network **103** and **104** may include a number of appliances **117** such as printers, file servers, mass storage and the like. Similarly, appliances **117** may be shared through network **101** to provide application and file services, directory services, printing, storage, and the like.

Environment **100** includes one or more network-connected human resources server(s) **108**. Human resources server **108** may be accessed by participants using appliances **117**. By way of example, human resources server **108** implements data structures and methods to accept job descriptions from hiring entities, store job descriptions, post job descriptions for access by potential applicants and other hiring entities and process employment inquires and acceptances. Other optional features may also be included in human resources server **108** including storage and display of auxiliary information such as contractor rate information by location and/or skills.

The present invention also contemplates the connection of one or more third party auxiliary service providers **111**. Auxiliary services **111** comprise, for example, services to manage candidate background checks, reference checks, drug testing, and similar services that may add value or information to an exchange between participants. For example, a credit reporting agency may provide real time background information on

a particular job applicant or potential employer. Because the information provided by auxiliary services **111** can be accessed in near real time, it may be readily factored into the total cost/benefit analysis of a particular exchange.

Human resources server **108** may also provide specialized services such as computation and comparison of employment offers and job descriptions using unique data that describes individual participants. Selecting employment from among a pool of available positions is a difficult decision involving many factors such as cost of relocation, salary, cost of living, commuting distance, and the like. Many of these factors are unique to a particular applicant. The optional specialized services in accordance with the present invention provide tools to compare diverse offers with consideration to applicant-specific preferences. Similarly, these specialized services assist in comparing applicants by taking into consideration relocation costs, employment agency costs, and other employer-specific factors that may differentiate between competing applicants.

Each of the devices shown in FIG. 1 may include memory, mass storage, and a degree of data processing capability sufficient to manage their connection to Internet **101**. The computer program devices in accordance with the present invention are implemented in the memory of the various devices shown in FIG. 1 and enabled by the data processing capability of the devices shown in FIG. 1. In addition to local memory and storage associated with each device, it is often desirable to provide one or more locations of shared storage (not shown) that provides mass storage capacity beyond what an individual device can efficiently use and manage. Selected components of the present invention may be stored in or implemented in shared mass storage.

FIG. 2 illustrates basic business processes involved in an implementation of the present invention while FIG. 3 illustrates functional components in an exemplary software architecture in accordance with the present invention to implement the processes of FIG. 2. Essentially, the present invention provides an integrated solution for identifying workers having skills that meet job specifications in identification process **201**. Identification process **201** also involves identification of jobs that have specifications meeting the desires and preferences of particular skilled workers. Process **201** includes matching engine processes **311** (shown in FIG. 3) for enabling a hiring manager to quickly identify a "short list" of qualified and available candidates for an available position. Process **201** provides functionality for hiring managers to efficiently post, edit and delete job descriptions. Once a match is created, match manager processes **312** automate the life cycle of the procurement process **202**. It allows participants to automate the workflow of finding a qualified candidate as well as placing and managing that candidate in their organization.

Hiring managers may optionally submit job descriptions to a selected supplier list in process **201**. Methods are included to enable hiring managers to manage interactions between the suppliers of the qualified applicants. Process **201** also provides equivalent functionality for the suppliers of candidates in posting, editing and deleting profiles or portfolios that are used to match against the job specifications. In a particular implementation, suppliers of resources automatically or manually match their candidates to jobs that they are made aware of via the Internet or by explicit notification.

While many features of the present invention involve identification process **201**, it is important to understand that these processes affect downstream processes such as procurement processes **202** and management processes **203**. Procurement processes **202** includes interview scheduling processes **322**

and employs messaging processes **334** to enable an employer and a candidate to move beyond the generation of a match and discuss specifics of a job opportunity. Exemplary functions include exchanging protected information between the parties (including sending company information and contact information to the participants), reviewing a detailed profile of the candidate, scheduling interviews with the candidate, and capturing interviewer feedback on a candidate in an on-line repository.

Processes **202** optionally include skills validation process **321** including pre-employment screening processes to provide independent verification of skills that are listed on the candidate profile. It is contemplated that these optional functions may include scheduling on-line testing of available skills tests with the candidate, scheduling independent verification of specific skill categories with candidate, entering and/or reviewing test or verification results on-line, and interfacing with other repositories of skills certifications. Processes **202** may also provide a means to manage candidate background checks, reference checks, drug testing, and the like using, for example, auxiliary services **111**.

Procurement process **202** provides interface(s) through which participants may perform contract management functions. Procurement process **202** optionally includes automated contract management components **323** (shown in FIG. **3**) that are used when the employer and job seeker are ready to enter into a contract for services. Employers and job seekers may enter a new contract/consulting agreement or copy one from an existing template or archive. The participants may extend and/or approve contract offers on-line in a preferred implementation. In other implementations, participants may receive automatic notification of contract termination, perform contract reporting to compare budget to actual dollars, percentage completion analysis and the like. Directly or through auxiliary services, procurement processes **202** optionally perform compliance reporting (EEOC, MBE/MWBE).

The procurement processes are typically provided to contract participants which may be supplier agents and hiring agents working on behalf of employees and employers, respectively. It is contemplated that procurement processes **202** may be provided directly to employees and/or employers even though the identification processes were provided indirectly through their respective agents. These modification and alterations are equivalent to the processes described herein.

Optional management processes **203** implement various interfaces and processes that enable participants to manage an employment contract after it is formed. Management processes **203** are particularly desirable in contract employment situations where the employment contract specifies certain activities, billing arrangements, payment arrangements, and progress criteria. A time and expense management component **341** provides interfaces to the processes associated with consultant timesheets and expense reports as a particular example. Component **341** includes entering and submitting timesheets and expense reports associated with specific work orders, reviewing and approving consultant timesheets and expense reports, including partial approval capability and support for multi-level approval chains, and reporting time and expense by work order, consultant, supplier firm, and the like. An interface through which clients may approve consultant time and expense may also be provided.

Automated payment services and billing module **342** uses data captured through components such as time and expense component **341** to generate and track invoices to customers, and payment received from customers. The processes associated with invoicing and payment of services may be per-

formed electronically, using technology such as XML and the OFS data interchange format either directly or through auxiliary services **111**. Contemplated functions include generating electronic invoices based on time and expense report approval, consolidating multiple vendor/supplier sources into a single invoice, cross-referencing invoices to timesheets/expense reports, approving electronic invoices, and allowing electronic transmission of funds based on approved invoices.

As shown in FIG. **3**, in a particular implementation of the present invention business processes **201**, **202** and **203** are implemented on top of foundation processes **310**. Foundation processes **310** include components such as Enterprise Java Beans, Servlets, Oracle 8i relational database technology, Web Logic application servers connected together using industry standard APIs and protocols in a particular implementation. Using a Java 2 Enterprise Edition (J2EE) architecture enabled the present invention to be implemented using an application service provider (ASP) model that provides browser-based universal access for a wide range of user types, reducing operational management complexity and cost of ownership. The architecture shown in FIG. **3** leverages a software component model that gives flexibility in deploying, managing and reusing business logic and allows incremental development and deployment of application components. This implementation also permits integration with third party applications by wrapping logic using enterprise Java Bean technology. Moreover, the architecture shown in FIG. **3** enables a robust enterprise environment that provides a scalable, consistent architecture with 7x24 availability on the World Wide Web (WWW).

The J2EE standard provides a model for developing distributed applications that are multi-tiered and use a thin-client strategy. Such applications are desirable for delivery via the Internet to conventional web browser software. This implementation reduces demands on client-side systems and enables a wide variety of appliances **117** (shown in FIG. **1**) to access the human resources services **108**.

The application is partitioned both across tiers and across functional groups. Partitioning across tiers allows distributed deployment, robustness under load stress and hardware failures, and integration of disparate component technologies and legacy applications into an integrated whole. Partitioning across functional groups permits easy expansion of application functions, modification of existing functions, as well as separate, specialized deployment of different functional groups based on user demand or hardware optimizations.

Common application components **330** are leveraged across all of processes **201**, **202** and **203**. Personalization component **333** enables the look-and-feel provided to participants to be customized to match the appearance of client and/or vendor web-sites, allowing functionality to be seamlessly integrated into customer intranets and web sites. The sequence of operations performed during the hiring process may also be tailored to a particular customer. As nearly all aspects of the hiring process in accordance with the present invention are data-driven (as opposed to event driven), users may be given the capability to tailor the application to match their hiring process by providing them with the tools to safely and consistently define their own data driving the hiring process.

Management reporting component **332** augments reports from other components, by providing additional general management reporting capabilities using the valuable data assets within the system. Component **332** provides various general reports generated from the system's data. Contemplated report types include consultant performance rating, supplier efficiency rating, inactive supplier/consultant reporting, and customer-driven reporting of available public information.

Desirably, the system will also provide the ability for users to create their own customized reports to enable them to turn their own data into valuable information.

Security component **331** enforces access controls on user data. A user may explicitly define who may view or edit data owned by the user, or act on messages generated for the user. Users may designate particular information (e.g., salary ranges) as confidential. User contact information is typically held confidential until explicitly released by the user.

In a particular implementation, the systems are protected against hostile network attack via a combination of FireWall-**106** software and IP security services provided by the Internet service provider **107** that provides connectivity between Internet **101** and human resources server **108**. Administrative access to systems is controlled via available remote access software.

FIG. 4 illustrates exemplary entities and data transactions in an implementation of the present invention. Human resources server **108** enables transactions between hiring agents **401** and human resource suppliers **402**. Hiring agents represent staffing agencies, human resource departments and personnel, and similar entities that are tasked with supplying human resources to meet the needs of one or more jobs. A hiring agent **401** may be an employer or an entity contracted to find skilled workers on behalf of an employer. Human resource suppliers **402** represent staffing agencies, job shops, headhunters and similar entities that represent one or more candidates or job applicants. It is contemplated that job applicants may access the system directly as well.

Hiring agents **401** generate one or more profiles **404**, shown in more detail in FIG. 11 that include attributes of job descriptions including information such as employer name, job title, salary, and other contract terms. Profile **404** will include some data that is public in that it can be shared with other participants with access to human resource server **108**. Profile **404** also includes restricted and private data that can be used by human resource server **108** but is either not shared with other participants or is shared with other participants according to rules specified by the associated hiring agent **401**. In this manner, profile **404** becomes an autonomous agent on behalf of the particular job represented by the profile **404** as it embodies self-contained rules enabling the use of data contained therein.

Supplier agents **402** also generate one or more profiles **406**, shown in more detail in FIG. 12, that include attributes of particular job applicants including information such as name, location, experience, educational background, salary needs, and the like. Like profile **404**, profile **406** will also include some data that is public as well as restricted and private data that can be used by human resource server **108** but is either not shared with other participants or is shared with other participants according to rules specified by the associated supplier agent **402**. In this manner, profile **406** becomes an autonomous agent on behalf of the particular job candidate represented by the profile **406** as it embodies self-contained rules enabling the use of data contained therein.

Human resources server **108** uses messaging component **334** (shown in FIG. 3) to receive and store received profiles **404** and **406** in data structures **414** and **416**, respectively, in a manner that is continuously accessible. Human resource server **108** uses match engine **311** to autonomously monitor data structures **414** and **416**. In contrast with search engine based solutions, match engine **311** is self-invoked or is invoked automatically upon the addition of profiles **404** and/or **406** to identify matches between profiles **404** and **406**.

Match engine **311** compares each job profile **404** against each job applicant profile **406** and generates one or more

scores indicating a degree of compatibility between the profiles. Match engine **311** generates a match record for each profile match. The match record includes identification information associated with the matching profiles **404** and **406** as well as match scores. Each match record has two different scores, how well the candidate meets the job requirements (this score is available to both the hiring agent and the supplier agent and determines whether or not a match record is created (i.e. over the threshold). The other score is how the job meets the candidate's requirements. In the preferred implementation, this second score is only shown to the supplier agent).

Match engine **311** generates a match list **407** of candidates having profiles **406** that are substantially compatible (i.e., have match scores greater than a predetermined threshold) with a particular profile **404**. The match list **407** includes the one or more scores for use by hiring agent **401** in assessing and comparing various candidates represented in the list. Match list **407** is communicated using messaging component **334** to the hiring agent **401** corresponding to the profile(s) **404** that are involved in the match.

Match engine **311** also generates one or more scores indicated a degree of compatibility of profiles **404** with a particular profile **406**. These scores reflect how well a particular job matches the requirements specified by a job applicant. Although the scores delivered to hiring agent **401** and the scores delivered to supplier agent **402** arise from the same set of data, they may differ in value when the scoring algorithms take into account the differences in perspective between a hiring agent and a job applicant.

Match list **408** comprises job descriptions and match records having profiles **404** that are substantially compatible (i.e., have match scores greater than a predetermined threshold) with a particular profile **406**. The match list **408** includes the one or more scores for use by supplier agent **402** in assessing and comparing various job descriptions represented in the list. Match list **408** is communicated using messaging component **334** to the supplier agent **402** corresponding to the profile(s) **406** that are involved in the match.

In the particular implementation, messaging component **334** is the primary interface for users when first connecting to human resources server **108**. Through this interface a user is immediately informed of objects in the system upon which the user may take action. The messaging component **334** provides email message capability to send notification of events within the business workflow to provide real time hiring process management. These notifications are configurable for each user and can be related to or triggered by events, (e.g. a match is accepted by hiring agent **401**) or to non-events (e.g. a hiring manager **401** accepted a match on a supplier's candidate but two days have elapsed since acceptance).

Messaging component **334** may also be used for more sophisticated delivery of discrete units of functionality to appliances **117** such as hand-held smart devices, such as personal digital assistants, smart cards and or smart phones. These discrete units of functionality (analogous to browser applets) may be executed on the hand-held device to interact with the systems of the present invention and perform operations such as accepting a match, submitting a time sheet, or approving an expense report.

Once one or more matches are identified, match manager component **312** handles workflow tasks such as generating match list **407** as well as further tasks shown in FIG. 5 and FIG. 6. A hiring agent **401** may review a match list and accept or express interest in one or more matches by generating a message **501** to server **108**. Depending on the business rules in effect, match manager **312** may notify supplier agent **402**

upon receipt of message **501**, or take alternative action such as providing detailed information message **502**. Message **502** includes, for example, information that may have been designated as restricted by the job applicant or supplier agent **402** and released only upon an expression of specific interest by a hiring agent **401**. The exchange of messages **501** and **502** may continue iteratively as hiring agent **401** gathers additional information about a particular identified match.

On the supplier agent side, a match list **408** is reviewed and supplier agent **402** may also accept or express interest in one or more matches by generating a message **511** to server **108**. Depending on the business rules in effect, match manager **312** may notify hiring agent **401** upon receipt of message **511**, or take alternative action such as providing detailed information message **512**. Message **512** includes, for example, information that may have been designated as restricted by the hiring agent **401** or employer and released only upon an expression of specific interest by a supplier agent **402**. The exchange of messages **511** and **512** may continue iteratively as supplier agent **402** gathers additional information about a particular identified match.

FIG. 6 illustrates data exchanges associated with an actual employment or consulting contract being formed. Although FIG. 6 suggests the contract is between hiring agent **401** and supplier agent **402**, it should be understood that it is intended that a contract is formed between a candidate employee or contractor and a corresponding employer and the respective agents only represent these parties. An offer message **601** is communicated by one of the parties, typically the hiring agent **401**, to human resources server **108**. The offer is communicated to the other party, typically supplier agent **402**, which can then reject or accept the offer by an accept message **602**. Once an offer message **601** and an accept message **602** have been communicated, a contract is formed. Contract message **603** is communicated to both parties, preferably including a contract summary or fully executed viewable/printable version of the engagement contract. In a particular example, human resource server **108** updates profiles within data stores **416** and **418** to indicate the effects of the contract (e.g., the position and candidate are no longer available for matching).

FIG. 7 shows exemplary state transitions involved in the matching and post match management processes in accordance with an embodiment of the present invention. Initially profiles exist in an unmatched state until a suitably compatible profile is identified by match engine **311**. During the unmatched state, a job requisition will compare all candidate profiles that are "active" and are associated with a list of supplier agents specified within the job requisition. When a candidate profile meets the defined threshold, a match is identified, an automatch record is created, and the profiles are transitioned to an automatched state which indicates that the resource profile **406** is substantially compatible with an associated job specification profile **404**.

Optionally, the auto-matched state may be entered manually when a supplier agent **402** or hiring agent **401** "forces" a match by bypassing the match engine processes. This enables a supplier agent **402** to generate a match record for a candidate that was either "inactive" or did not meet the scoring threshold. These candidates profiles still go through the match engine for scoring, but are not subject to the minimum threshold test ordinarily applied to automatches. Another optional feature enables a hiring agent specify a named resource or candidate on the job requisition which will similarly force a match irrespective of the scoring and thresholds.

The automatch state is exited when either the supplier agent **402** or hiring agent **401** accept or reject the automatch. If either agent rejects the automatch, the hiring process is

terminated. The process may be terminated as well when one agent responds, but the other does not, or when neither agent responds within a selected period of time. Both agents must accept the match to transition to a "courting" state.

The courting state indicates that both parties have indicated willingness to pursue the match. In the courting state, the parties may exchange the private information in accordance with pre-specified disclosure rules. Match manager component **312** tracks progress of various sub-processes that are optionally employed. The courting state includes one or more sub-states handling the various sub-processes. A match need not pass through all sub-states to make the transition to the interview pending state, and there is no order imposed on the transition between sub-states (i.e., the processes are concurrent). Exemplary sub-states of the courting state include background checking, reference checking, skill validation and the like. Background checking refers to background checks such as drug tests, criminal history checks, credit checks, BI/SBI, and the like. Reference checks involve contacting references identified by the job applicant, for example and may include checking on-line past-performance information maintained by human resource server **108** itself. Skill validation involves certifying any abilities for which hiring agent **401** has requested certification.

Upon satisfactory completion of courting state sub-processes, the match transitions to an interview state where in person, telephone, video conference or other interview processes are executed. Typically a job applicant is interviewed by one or more representatives of hiring agent **401** or the actual employer represented by hiring agent **401**.

The interview state is typically exited by communication of an offer to a job applicant at which time the offer pending state is entered. The offer pending state may persist for a variable length of time while an offer is considered and counteroffers and negotiations take place. Upon reaching an agreement, an acceptance is communicated resulting in a transition to a contracted or closed state.

FIG. 8 illustrates functional components, typically implemented as software, within an exemplary matching engine **311**. In a particular implementation, three separate matching processes are performed to generate three distinct scores for each match. In each of the matching processes, data from profile databases **414** and **416** is used to generate scores for both the supplier agent **402** and the hiring agent **401**. The matching processes generate a similarity index using the structured format of profiles **404** and **406** in combination with a hierarchical and context-sensitive analysis of words and terms used to create profiles **404** and **406**. In this manner, the matching processes identify a larger set of meaningful matches and may be used in combination with available fuzzy logic matching techniques. Once a similarity index is determined, scores are computed by normalizing and weighting factors to the index.

The final scores are normalized to a convenient scale such as 1-100 that provides a quantitative assessment of the substantiality of the compatibility between two profiles. Skills and education component **801** matches skills requirements as well as educational requirements listed within profiles **404** and **406**. Location component **802** generates a matching score on geographic preferences and/or requirements. Compensation component **803** generates a score based on compensation desires and requirements. While it is possible to mathematically combine these three scores into a single index using weighting algorithms, the particular implementation provides the scores separately so that the hiring agent **401** and/or supplier agent **402** have more information upon which to base their decisions and negotiations.

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FIG. 9 and FIG. 10 show exemplary user interfaces used to enter job candidate information for use in a profile 406. Similar user interfaces are used to obtain hiring agent or job specification information. FIG. 9 and FIG. 10 shows an interface generated in a web browser window in a Microsoft Windows operating environment, although other operating environments and user interface platforms that can display user input controls, including command line input screens, would be appropriate substitutes in some applications. The interfaces shown in FIG. 9 and FIG. 10 include a plurality of user input controls such as text input boxes, radio buttons, check boxes, pull down boxes and the like. Information and instruction is conveyed by text fields positioned adjacent the appropriate user input controls although instruction may be conveyed by floating help boxes as well as audio, video and multimedia communication means. In FIG. 9 and FIG. 10 the user input controls correspond to attributes in a profile 406 that can be communicated to and persistently stored in human resources server 108.

In FIG. 9 the information that is gathered includes basic identification information such as name, job title, social security number, and contact information. Status information indicates whether the associated job applicant is actively seeking another position. Resource type information enables the user to distinguish between contract employees and permanent employees, for example. Other information is gathered for use in matching with job description profiles 404 such as availability dates and an indication of supplier agent (s) that are managing the particular job applicant.

In addition to the identification and management information, job applicant skills, education, roles, and preferences are indicated in various user input controls shown in FIG. 9 and FIG. 10. In FIG. 9, the user scrolls through a constrained list of skill titles and selects the "add skill" button to add the skill to the inventory list shown in FIG. 10. Similarly, the user selects from a constrained list of applicable roles and selects the "add role" control to include the role on the inventory list of FIG. 10. Once all applicable skills and roles have been identified, the interface shown in FIG. 10 is presented to obtain applicant-specific quantification of the skills and roles selected. An exemplary set of quantification information includes a judgment as to relative level of a particular skill (e.g., selected from "novice", "trained", "intermediate", "expert" and "guru" in the particular example). Any gradation and granularity of skills rating can be applied. Years of experience tends to be a numeric input that is constrained to reasonable year ranges (e.g., less than one year to 40 years).

One feature of the present invention is that preferably a "Preference" control is associated with each skill/role. This enables the job applicant to indicate whether he/she desires to use a particular skill in a future job assignment. Even where the skill or role is listed as "not required", match engine 311 can use the information provided to ensure better matches while appropriately reflecting the preference in the score given to the supply agent 402.

Another feature of the present invention is the ability to select visibility on an attribute-by-attribute basis. A particular attribute may be indicated as private, public, or protected in the particular example. Public variables will be available to a wide range of participants, whereas private variables may not be communicated to other participants (although still used by match engine 311). Private attributes may be communicated under very restrictive conditions in some implementations. Restricted attributes can be disclosed as specific states in the hiring process such as the "courting" state described in reference to FIG. 7.

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Other information that may be included are a resume, and compensation information. These items may also be access-controlled by public, private and restrictive labels. Any type and variety of other information may be collected and stored in a profile 406.

Although the invention has been described and illustrated with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example, and that numerous changes in the combination and arrangement of parts can be resorted to by those skilled in the art without departing from the spirit and scope of the invention, as hereinafter claimed.

What is claimed is:

1. A computer system for resource management, comprising:
  - a server operative for executing instructions embodied as software; and
  - a plurality of software portions comprising
    - one of said software portions configured as a hiring agent for generating a plurality of needs profiles, wherein each needs profile comprises a first data record specifying attributes about a need;
    - one of said software portions configured as a supplier agent for generating a plurality of capability profiles, wherein each capability profile comprises a second data record specifying a set of attributes of an entity qualified to meet a need and the second data record further comprises attributes describing the associated entity's preference to utilize one or more specified skills in future job assignments; and
    - one of said software portions configured as a matching engine and coupled to the first and second data records and for autonomously monitoring and comparing the first and second data records and generating at least two scores indicating a compatibility between the capability and needs profiles, wherein at least one of the at least two scores indicates how well a capability profile meets a needs profile and at least another of the at least two scores indicates how well a needs profile meets the entity's requirements and to identify the needs profile and entity.
2. The system of claim 1, wherein each needs profile comprises attributes that describe a human resources need and each capability profile comprises attributes that describe skills of a job candidate.
3. The system of claim 2, wherein the job candidate attributes include attributes describing the associated candidate's qualifications.
4. The system of claim 1, wherein the first data record is persistent.
5. The system of claim 1, wherein the second data record is persistent.
6. The system of claim 1, further comprising:
  - a user interface for gathering information from a job application.
7. The system of claim 1, further comprising:
  - a network interface configured to communicate the first and second data record and to the matching engine.
8. A computer system for resource management, comprising:
  - a user interface associated with a computing appliance for gathering information from a job applicant;
  - a machine operative for executing instructions embodied as software; and
  - a plurality of software portions, wherein
    - one of said software portions is configured for generating a first data record from the gathered information,



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the data record comprising a plurality of attributes profiles describing skills of an associated job applicant;

one of said software portions is configured for generating a second data record comprising a plurality needs profiles of an entity having a capability of meeting a need, wherein at least one of the first and data records comprises at least one restricted information section; and

one of said software portions is configured to couple a matching engine to a network interface, to communicate the first and second data records, to automatically match at least one of the plurality of attributes profiles with at least one of the plurality needs profiles based on correspondence of attributes of the at least one restricted information and to provide an identification of the match but not the at least one restricted information.

**9.** The system of claim **8**, wherein the data record is formatted to enable the matching engine to readily detect

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matches between described skills and required skills of a hiring agent data record accessible by the matching engine.

**10.** The system of claim **8**, wherein each need profile comprises attributes that describe a human resources need and each capability profile comprises attributes that describe skills of a job candidate.

**11.** The system of claim **8**, wherein the first data record is persistent.

**12.** The system of claim **8**, wherein the second data record is persistent.

**13.** The system of claim **8**, further comprising:  
a user interface for gathering information from a hiring agent.

**14.** The system of claim **8**, further comprising:  
a network interface configured to communicate the first and second data record and to the matching engine.

\* \* \* \* \*